

discharge producing electrodes such that essentially the only activated nitrogen impinging on the substrate is  $N_2A^3\Sigma_u^+$ .

13. (Amended) The apparatus according to claim 12, further comprising a nozzle with a nitrogen emersion orifice in the nitrogen delivery path, a first one of the corona-discharge electrodes being a cathode proximate the nitrogen emersion orifice of the nozzle, a second of the corona-discharge electrodes being spaced from the nitrogen emersion orifice of the nozzle and the first one of the corona-discharge electrodes, a skimmer located downstream of the nozzle in the direction of nitrogen flow, the skimmer defining an opening to collimate a beam of activated nitrogen molecules passing therethrough, at least one chamber downstream of the skimmer, means for evacuating the chamber to draw off gases other than the activated nitrogen molecules prior to the activated nitrogen molecules reaching the substrate.

14. (Amended) The apparatus according to claim 13, wherein the at least one chamber comprises one of a plurality of at least two succeeding chambers with means for evacuating each of the succeeding chambers to draw off gases other than the activated nitrogen molecules passing therethrough towards the substrate, each succeeding chamber in the direction of nitrogen flow being evacuated to a lower interior pressure, the last of the downstream chambers containing the means to locate a substrate and, in operation, containing at the location of the means to locate a substrate predominantly ground state  $N_2$  molecules and  $A^3\Sigma_u^+$  state metastable  $N_2$  molecules, whereby the metastable  $N_2$  molecules impacting a substrate deliver a single N atom, the further N atom of the  $N_2$  pair carrying from the site of impact energy of reaction.

15. (Amended) The apparatus according to claim 14, wherein the nozzle comprises a restricted end of a tube, the tube being in the nitrogen delivery path, the cathode being located within the tube, and the second of the corona discharge electrodes being electro-positive relative to the cathode and located outside the tube, the nitrogen emergent from the tube into a corona discharge between the electrodes forming with the corona discharge a corona discharge supersonic free-jet.

36. (Amended) Apparatus for producing a film on a semiconductor-substrate comprising:

(a) means for establishing a vacuumized environment,  
(b) means for establishing a corona discharge in the vacuumized environment,  
(c) means for creating a flow of nitrogen gas into the corona discharge and a supersonic jet of diatomic, activated metastable nitrogen molecules from the corona discharge,  
(d) means for collimating the jet of nitrogen molecules, and  
(e) means for locating a target semiconductor substrate in the path of the collimated jet of nitrogen particles at a distance from the means for establishing a corona discharge such that substantially only diatomic nitrogen molecules of the form  $N_2A^3\Sigma_u^+$  and  $N_2X^1\Sigma_g^+$  are present at that distance.

A2  
39. (New) The apparatus according to claim 36, further comprising:

(f) means for controlling the temperature of the substrate.

A3  
40. (New) The apparatus according to claim 39, wherein the means for controlling the temperature comprises means for bringing the substrate to a temperature below 900°C.

41. (New) The apparatus according to claim 36, further comprising a source of a reagent in addition to the nitrogen for delivering the reagent to the substrate with the metastable nitrogen molecules to form on the substrate a layer that is a nitride of the reagent.

42. (New) The apparatus according to claim 12, further comprising at least one further corona-producing electrode and at least one further nitrogen delivery path to at least one further nozzle.

43. (New) The apparatus according to claim 42, wherein the pair of corona discharge electrodes, the at least one further corona-producing electrode, and the nitrogen delivery paths are part of an array of multiple, activated nitrogen molecule plasma production means opening into a vacuumized chamber.

44. (New) The apparatus according to claim 12, further comprising a source of nitrogen and argon in communication with the nitrogen delivery path, whereby a mixture of nitrogen and argon is delivered along the path to the substrate location.

45. (New) The apparatus according to claim 14, wherein, in operation, the pressure in each succeeding chamber is 1/10 or less than the preceding chamber.

46. (New) The apparatus according to claim 45, wherein, in operation, the first chamber, into which the nozzle opens has a pressure less than  $10^{-6}$  Torr.

47. (New) An apparatus for producing a dielectric insulator film comprising:

- (a) at least one corona-discharge producing electrode pair,
- (b) at least one source of a pressurized reagent gas,
- (c) at least one path of reagent gas flow to at least one nozzle proximate the tip of one electrode of the at least one pair and in the region of corona discharge,
- (d) a reduced pressure location at an outlet of the nozzle into which the reagent gas emerges as a supersonic jet of activated reagent molecules,
- (e) a skimmer downstream of the nozzle in the direction of flow of the supersonic jet, and
- (f) a substrate location downstream of the skimmer, in operation locating a substrate for formation thereon a dielectric film composed at least in part of the reagent.

48. (New) The apparatus according to claim 47, wherein the substrate location is at a distance downstream of the nozzle such that the activated reagent molecules are substantially only ground state molecules and activated molecules of the  $A^3\Sigma_u^+$  state.

49. (New) The apparatus according to claim 48, wherein the at least one source of a pressurized reagent gas is a source of diatomic molecules of reagent gas, the activated molecules arriving at the substrate location are diatomic molecules of the  $A^3\Sigma_u^+$  state.